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10/663,691	09/17/2003	Yasuhisa Inao	00684.003542.	5236

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EXAMINER

RUGGLES, JOHN S

ART UNIT	PAPER NUMBER
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1756

DATE MAILED: 12/01/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/663,691

Applicant(s)

INAO ET AL.

Examiner

John Ruggles

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 08 September 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-16 is/are pending in the application.
- 4a) Of the above claim(s) 5-14 and 16 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-4 and 15 is/are rejected.
- 7) ☒ Claim(s) 1-4 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 17 September 2003 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
- 1) ☒ Certified copies of the priority documents have been received.
 - 2) ☐ Certified copies of the priority documents have been received in Application No. _____.
 - 3) ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date 12/19/03.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION***Election/Restrictions***

Applicants' election with traverse of Group I (claims 1-4 and 15) in the reply filed on 9/8/05 is acknowledged. The traversal is on the ground(s): (A) Groups I and IV are asserted to not be unrelated inventions as set forth in MPEP § 806.04, MPEP § 808.01 and (B) that examining all of Groups I, II, III, and IV together in the same application is argued to not require an undue burden on the Examiner under MPEP § 808 that is significantly beyond that of the normal burdens of examination.

However, this is not found persuasive for at least the following reasons. (A) The different inventions of Groups I and IV have different modes of operation and different functions at least because the methods of Group I require contact exposure, but the method of Group IV does not recite the use of a contact exposure apparatus and this method of Group IV is not disclosed as capable of use together with the contact exposure methods of Group I (as previously pointed out and not specifically refuted by Applicants). The different inventions of Groups I and IV are both unrelated and distinct under MPEP § 806.04 and MPEP § 808.01. (B) In addition, Groups I, II, III, and IV were previously shown to be distinct inventions that have acquired a separate status in the art as shown by their different classification as well as their recognized divergent subject matter (both of which were previously indicated and neither of which has been specifically disputed by Applicants). Also, examination of these distinct inventions together would place serious additional burden on the USPTO Examiner for conducting the diverse additional search(es) that would be required for each of these distinct inventions (MPEP § 808.02).

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Furthermore, MPEP § 803 states, in part, “a serious burden on the examiner may be *prima facie* shown if the examiner shows by appropriate explanation of separate classification, or separate status in the art, or a different field of search as defined in MPEP § 808.02”. The distinct inventions of Groups I, II, III, and IV have been previously shown to be separately classified, so Applicants’ request to withdraw the previous restriction requirement would place a serious additional burden on the Examiner. Therefore, the restriction requirement is still deemed proper and is now made FINAL.

Claims 5-14 and 16 are withdrawn from further consideration pursuant to 37 CFR 1.142(b), as being drawn to nonelected inventions.

Drawings

The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they do not include the following reference sign(s) mentioned in the description: (i) the alternative mask “440” (that is smaller than the plate 700) is found in the description of Figure 1 at page 19 line 1, but “440” is not actually shown in Figure 1, but rather is shown to be just the “thin film” portion (including patterned light blocking film 430 on mask base 420) of the mask 400 shown in Figure 2B; (ii) the substrate “701” found in the description of Figure 1 at page 31 line 24 is not actually shown in Figure 1 (but it is believed that Applicants may have intended the substrate to be --[[701]] 710--, as found in Figure 1 and previously identified to be the substrate at least at page 28 line 26); (iii) the circular polarization transforming system “300A” described at page 47 lines 2-4 in reference to Figure 9 is not shown by this drawing (although the position of the reference number --300-- shown by Figure 9 seems to take the place of “300A”); and (iv) the

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thin film "440A" described at page 48 line 11 in reference to Figures 7A and 7B is not shown by either of these drawings.

The drawings are also objected to as failing to comply with 37 CFR 1.84(p)(4) because (v) reference character "100" has been used to designate all of (a) the light source unit shown by Figure 1 as described at page 18 line 18 (b) the Si mask substrate (for making a mask supporting member 410 of the mask 400) found in the description at page 41 lines 21-23 (presumably in reference to Figure 1, Figure 2A, and/or Figure 2B) and (c) the silicon wafer Si (for making a mask supporting member 410A of the mask 400A) found in the description at page 55 line 23 (presumably in reference to Figure 6, Figure 7A and/or Figure 7B).

The drawings are further objected to because (vi) the pressure adjusting system "600" in Figure 6 as described at page 55 lines 4-5 should be redirected to point to the portion of the exposure apparatus 1A that includes 630 and 640 rather than that which includes 620.

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

In addition to Replacement Sheets containing the corrected drawing figure(s), Applicants are required to submit a marked-up copy of each Replacement Sheet including annotations

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indicating the changes made to the previous version. The marked-up copies must be clearly labeled as "Annotated Sheets" and must be presented in the amendment or remarks section that explains the change(s) to the drawings. See 37 CFR 1.121(d)(1). Failure to timely submit the proposed drawing and marked-up copy will result in the abandonment of the application.

Specification

35 U.S.C. 112, first paragraph, requires the specification to be written in "full, clear, concise, and exact terms." The specification is replete with terms, which are not clear, concise and exact. The specification should be revised carefully in order to comply with 35 U.S.C. 112, first paragraph. Examples of some unclear, inexact or verbose terms used in the specification are: (1) at page 2 lines 25-26, "mask surface t cause damage" should be changed (e.g., to --mask surface to cause damage--, etc.); (2) at page 5 lines 12-13, "it would not go beyond about 0.4" should be clarified to --[[it]] the proportional constants would not go ~~beyond~~ below about 0.4--; (3) at page 5 line 26, --because-- has been misspelled; (4) at page 19 line 20, "300" should be corrected to --[[300]] 400-- in reference to the mask shown in Figure 1, to which this passage refers; (5) at page 39 line 14 and at page 45 line 21, the mask "440" should be corrected to the mask --[[440]] 400-- at both occurrences, in order to be consistent with the reference number corresponding to the mask shown in Figure 1; and (6) at page 48 line 23, "mask as viewed in Figure 7" should be changed (e.g., to --the mask as viewed in Figure 7B--, etc.). (7) Applicants should also correct all other similar errors to those listed above throughout the specification (e.g., at page 49 line 7 "Figure 7" should be changed to --Figure [[7]] 6--, etc.). Note that due to the

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number of errors, those listed here are merely examples of the corrections needed and do not represent an exhaustive list thereof.

Appropriate correction is required. An amendment filed making all appropriate corrections must be accompanied by a statement that the amendment contains no new matter and also by a brief description specifically pointing out which portion of the original specification provides support for each of these corrections.

Claim Objections

Claims 1-4 are objected to because of the following informalities: in claim 1 line 4, “exposure light being polarized” should be changed to --exposure light [[being]] that is polarized--. Claims 2-4 depend on claim 1. Appropriate correction is required.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 2-4 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In claim 2 line 2, “the lengthwise direction” (singular) lacks proper antecedent basis. It is unclear to which of the “lengthwise directions” (plural) in claim 1 (on which claim 2 depends) this singular lengthwise direction in claim 2 is meant to refer.

In claim 3 lines 2-3, it not fully clear whether the “exposure light” in line 2 is the same or different from the exposure light in claim 1 (on which claim 3 depends). Also, “the lengthwise direction” (singular) lacks proper antecedent basis. It is unclear to which of the “lengthwise directions” (plural) in claim 1 (on which claim 3 depends) this singular lengthwise direction in claim 3 is meant to refer. For the purpose of this Office action and in order to advance the prosecution of this application, claim 3 lines 2-3 have been interpreted to mean --the exposure light [[being]] is polarized in a direction with an angle of approximately 45° with respect to the lengthwise directions of the opening[[,]] ~~is projected onto the mask--~~.

In claim 4 lines 1-2, it is unclear whether the phrase “the mask has an opening formed only in mutually orthogonal directions” was intended to mean (1) the same opening formed with lengthwise directions extending in orthogonal directions that is recited in claim 1 (on which claim 4 depends) has only mutually orthogonal lengthwise directions (without any other lengthwise direction) or (2) a different opening from the opening formed with lengthwise directions extending in orthogonal directions that is recited in claim 1 (on which claim 4 depends) has only mutually orthogonal lengthwise directions (without any other lengthwise direction). For the purpose of this Office action and in order to advance the prosecution of this application, the above phrase in claim 4 has been interpreted to mean --the mask has an opening of the mask is formed with lengthwise directions extending only in mutually orthogonal directions--, in accordance with (1) above.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claim 1 and 4 are rejected under 35 U.S.C. 102(b) as being anticipated by Ebbesen et al. (US Patent 6,236,033).

Ebbesen et al. teach enhanced optical transmission apparatus utilizing metal films having apertures (title) for various applications, including near-field optical devices and masks for sub-wavelength photolithography (abstract, col. 2 lines 27-28). Figure 17A shows a mask having a metal blocking layer with an H-shaped opening made up of first parallel slit openings connected by a perpendicular interlinking second slit opening for exposure of an underlying substrate 140 coated with a photosensitive material such as resist. The resist on the underlying substrate is exposed to form an H-shaped image as shown in Figure 17B (col. 15 lines 25-30). When the diameter or width (d) of the near field mask opening or aperture is $< \text{the wavelength of exposure light } (\lambda)$, the transmission of light for exposure is proportional to $(d/\lambda)^4$ (col. 1 lines 20-29, which is understood to mean that near field exposure of a resist would require either close contact between the near field mask and the resist or at least close spacing between the mask and the resist to achieve sufficient intensity for the exposure). The exposure wavelength is much greater

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than the size of apertures or the width of slit openings (124a, col. 15 lines 18-20, even to the extent that the ratio of slit opening width to the exposure wavelength can be as small as about 0.1, col. 2 lines 61-67) and this exposure wavelength is described to come from a "regular UV light source" instead of a deep-UV source (col. 15 lines 40-42, which is understood to mean that the exposure wavelength is in the range of 300 nm to 400 nm and suggests the desirability for close contacting of the resist to the near field mask during exposure). Therefore, the slit opening width can be as small as 0.1 times the exposure wavelength or about 30 nm to 40 nm. When the incident exposure light is "p-polarized" to have an electric field parallel to the x-axis while the metal film is rotated about the y-axis through an angle θ as shown by Figure 7, the coupling of light with surface plasmons on the metal surface with any periodic structure (such as a periodic surface topography or a periodic array of apertures or slit openings) follows momentum conservation (col. 9 lines 23-30, reading on instant claims 1 and 4 for closely contacted resist exposure through a mask light blocking film opening with lengthwise directions extending only in mutually orthogonal directions using exposure light polarized in a direction other than the mutually orthogonal lengthwise directions of the mask opening). The beneficial increase in photon energy or light intensity for the metal surface having periodic structures is shown by Figure 8B in comparison to Figure 8A for the metal surface without periodic structures (col. 10 lines 1-7).

Claim 15 is rejected under 35 U.S.C. 102(e) as being anticipated by Naya (US Patent Application Publication 2002/0196420).

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Naya teaches a near-field exposure system or apparatus and method for imaging a photosensitive material or resist (title, abstract). In order to ensure sufficient near-field light exposure, the resist 11 is closely contacted to a near-field mask 14 during exposure (as shown in Figure 2, paragraphs [0052, 0057]). When the mask has pattern openings constituted by lines extending in more than one direction (which encompasses a mask having an opening formed with lengthwise directions extending in plural directions), circularly polarized exposure light (that is polarized in a direction other than those of the opening lengthwise directions on the mask) should be used to prevent uneven exposure or thickening of imaged lines from the mask opening having different lengthwise directions so that a fine pattern in the resist can be formed during exposure ([0070, 0071], instant claim 15).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-4 are rejected under 35 U.S.C. 103(a) as being unpatentable over either Kuroda et al. (US Patent 6,171,730) or Kuroda et al. (US Patent 6,187,482) in view of Alkaisi, M. M. et al., "Sub-diffraction-limited patterning using evanescent near-field optical lithography", (1999) Applied Physics Letters, Vol. 75, No.22, Pages 3560-3562.

Kuroda et al. '730 teach a near field evanescent light exposure process and a near field exposure apparatus that includes a near field mask having an opaque shading layer with aperture widths of about 100 nm or less (title, abstract), but preferably in the range of 1-100 nm, as shown by Figures 2A and 2B (col. 5 line 41 to col. 6 line 40). Figures 1A and 1B show close contact between the mask 106 and the resist 107 during exposure (col. 3 lines 58-67 and col. 5 lines 9-24). Figure 2A shows rectangular block form L-shaped slit openings in the opaque shading layer on the near field mask (col. 6 lines 40-42, which reads on the instant claims for resist exposure through a mask opening formed with lengthwise directions extending only in different and mutually orthogonal directions).

Kuroda et al. '482 teach a near field mask for evanescent light exposure and an apparatus for making a pattern using the near field mask (title, abstract). The mask includes a transparent base or substrate 201 and a metallic thin film shading member 203 having minute apertures 204, each having a width < 100 nm, which is small in comparison with the wavelength of exposure light (abstract, Figure 2, col. 4 lines 49-54). Figure 1 shows close contact between the mask 106 and the resist 107 having an adsorption preventing film during exposure (col. 4 lines 1-2 and 30-32). Figure 3A shows hook-shaped (rectangular block form L-shaped) slit openings 303 having two perpendicular lengthwise directions in the opaque shading layer on the near field mask (col. 8 lines 10-14, which reads on the instant claims for resist exposure through a mask having an opening formed with lengthwise directions extending only in different and mutually orthogonal directions).

Neither Kuroda et al. '730 nor Kuroda et al. '482 specifically teach *[1]* that the light for exposure of the resist is polarized in a direction other than the lengthwise orthogonal directions

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of the mask opening (instant claim 1); [2] that the opening of the mask is formed with lengthwise directions extending only in mutually orthogonal directions (instant claim 4); [3] that the exposure light is polarized in a direction at an angle of approximately 45° with respect to the lengthwise orthogonal directions of the mask opening (instant claim 3); nor [4] detecting the lengthwise directions of the mask opening for controlling exposure of the resist (instant claim 2).

Alkaisi et al. teach clear and faithful reproduction through a near-field mask having rectangular apertures or openings that are 70 nm wide (which is $< 1/5$ times the wavelength of incident light). High transmission (intensity of transmitted light) through the mask openings is always achieved for at least one polarization of incident light through the near-field mask as shown by Figure 2(b) (page 3561, left col., fourth full paragraph). Polarization of incident light in the direction perpendicular to the length (in the same direction as the width) of mask apertures (for transverse magnetic (TM) polarization) results in high light transmission through the mask openings to expose a resolved pattern in the top 40 nm of the resist layer (as shown in Figure 3(a) on page 3562, left col., last paragraph), whereas polarization of incident light in the direction parallel to the length of mask openings (for transverse electric (TE) polarization) does not result in a clearly resolved pattern to any depth at all in the resist layer (as shown in Figure 3(b) on page 3562, right col., lines 1-4). Thus, exposure of the resist will be dominated by the well-resolved, high-intensity TM polarization profile (page 3562, right col., lines 4-7).

It would have been obvious to one of ordinary skill in the art at the time of the invention that a process of exposing a resist through a near field mask having an opening formed with lengthwise directions extending in only first and second mutually orthogonal directions (as taught by either Kuroda et al. '730 or Kuroda et al. '482) by linear polarized exposure light

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aligned in the same direction as the width of the first lengthwise opening direction (such that the exposure light is polarized at an angle of 90° from the first lengthwise opening direction) on the mask would be expected to cause exposure of the resist that is dominated by a well-resolved, high-intensity polarized profile only under the first lengthwise opening direction on the near field mask (full intensity exposure, as taught by Alkaisi et al.). However, no significant exposure at all would be obtained in the resist under the second lengthwise mutually orthogonal opening direction on the mask (which runs in a direction at an angle of 0° from the direction in which the exposure light is polarized, no intensity exposure, as taught by Alkaisi et al.). In order to achieve a uniform exposure through both of the first and second mutually orthogonal directions of the mask opening, it would have been obvious to one of ordinary skill in the art that the linear polarization of the exposure light should not be aligned with either the first or the second mutually orthogonal directions of the mask opening [1,2]. In fact, it would logically be expected from the teachings of either Kuroda et al. '730 or Kuroda et al. '482 in view of Alkaisi et al. that the intensity of exposure light on the resist under both the first and second mutually orthogonal directions of the mask opening can be at least nearly equalized when the exposure light is linearly polarized in a direction at an angle of about half-way between 0° and 90° (or approximately 45°) with respect to the first and second lengthwise mutually orthogonal directions of the mask opening [3]. The nearly equalized exposure intensity would be about half of the former full intensity under the first lengthwise opening direction for exposure light linearly polarized at an angle of 90° thereto. In practice, it is well known in the art of resist exposure that the characteristics of the mask must necessarily be determined and utilized to set optical exposure conditions (e.g., for at least the reasons taught by Alkaisi et al., etc.). Therefore, it

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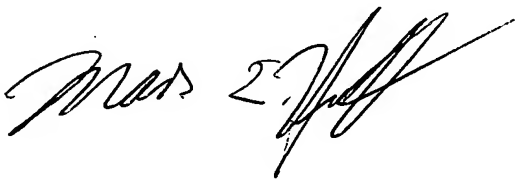
would also have been obvious to detect the lengthwise mutually orthogonal directions of the mask opening before determining or controlling the exposure light linear polarization and intensity on the basis of the detected lengthwise mutually orthogonal directions of the mask opening, in order to ensure the desired degree of uniform exposure in the underlying resist [4].

Conclusion


Any inquiry concerning this communication or earlier communications from the examiner should be directed to John Ruggles whose telephone number is 571-272-1390. The examiner can normally be reached on Monday-Thursday and alternate Fridays.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Huff can be reached on 571-272-1385. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



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